

Toward Universal Information Models in Enterprise Management

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Mgmt. Info. Modeling in the IP World



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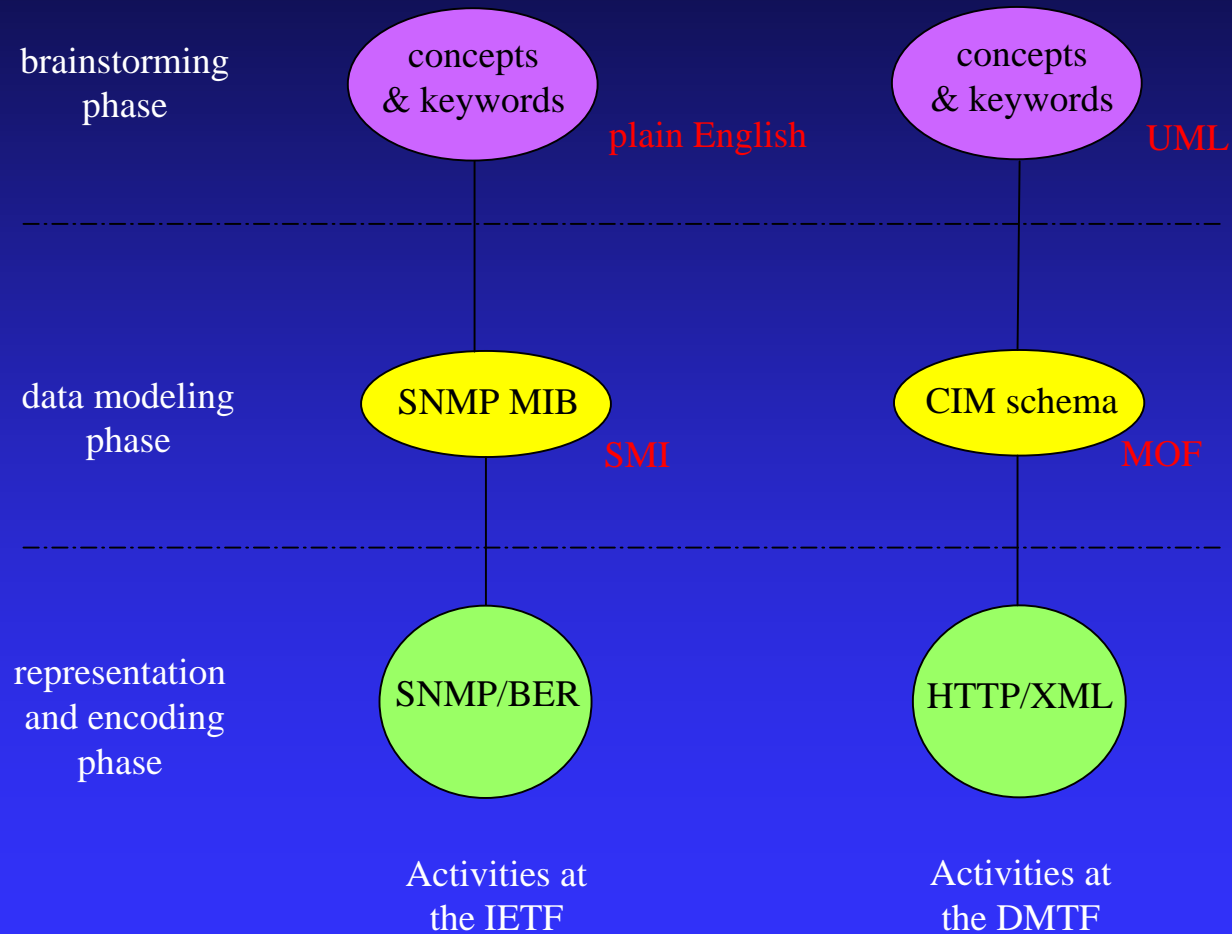
Enterprise Mgmt. in the IP World

- Enterprise mgmt.: Mgmt. of networks, systems, applications, services, policies, etc.
- Internet Engineering Task Force (IETF):
 - ◆ Simple Network Management Protocol (SNMP)
 - ◆ Management Information Bases (MIBs)
- Distributed Management Task Force (DMTF):
 - ◆ Web-Based Enterprise Management (WBEM)
 - ◆ Common Information Model (CIM) schemas

Technology-Independent Standardization Activities in Mgmt. Info. Modeling

- Metamodel:
 - ◆ DMTF: variant of UML metamodel
 - ◆ class, object, association, etc.
 - ◆ IETF: implicit metamodel
 - ◆ everything in a MIB is an OID (object identifier)
- Language:
 - ◆ SNMP MIBs: SMI
 - ◆ CIM Schemas: MOF
- Representation and encoding of mgmt. data:
 - ◆ IETF: BER
 - ◆ DMTF: XML, CIM Operations over HTTP

Per-Technology Standardization Activities in Mgmt. Info. Modeling



Four Problems in Mgmt. Info. Modeling



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Finding the Right Level of Abstraction Between Two Extremes

- Overly abstract models:
 - ◆ e.g., OMG's four-tier metamodel architecture
 - ◆ devised by theoreticians for theoreticians
 - ◆ over-engineering antipattern
- Overly detailed models:
 - ◆ e.g., SNMP MIBs
 - ◆ bottom line blurred by details
 - ◆ devised by developers for developers
 - ◆ under-engineering antipattern

The *Reinvent the Wheel* Antipattern

- Many standards bodies in the management arena: IETF, DMTF, OMG, TMF, ISO, ITU-T, Open Group, etc.
- Little cross-pollination between them:
 - ◆ *not invented here* syndrome
 - ◆ no time to read the literature -> start from scratch
- Consequences:
 - ◆ Terminology keeps changing:
 - ◆ e.g., DMTF: event, notification, indication
 - ◆ customers are confused
 - ◆ Standards bodies waste precious time
 - ◆ Interoperability left to sheer luck

Some Models Are Not Good Enough (1/2)

- Problem:
 - ◆ Some models contain errors:
 - ◆ e.g., RFC 1156 immediately replaced with RFC 1213
 - ◆ Some models miss important features:
 - ◆ e.g., no per-interface ACLs in RFC 1213
 - ◆ must use telnet

Some Models Are Not Good Enough (2/2)

■ Causes:

- ◆ WGs are mostly driven by vendors:
 - ◆ poor trade-off between quality and timeliness
 - ◆ fast design is not beautiful...
- ◆ Mgmt. standardization efforts often fail to attract the best technology experts and the best info. modelers in the world
- ◆ Fuzzy requirements:
 - ◆ e.g., what dials and knobs do we need to manage MPLS-based VPNs?

The Learning Curve Is Too Steep

- Newcomers are swamped by details:
 - ◆ must read SMI fluently to understand SNMP MIBs
 - ◆ must read MOF fluently to understand CIM schemas
- Newcomers need a better way to understand first the bottom line, and then the details

Analysis

Analysis (1/2)

- Going from one mgmt. architecture to another does not make the mgmt. issues any different for a given technology:
 - ◆ Isolate the architecture-independent core from the rest:
 - ◆ facilitate reuse
 - ◆ render the design cleaner
 - ◆ decrease the risks of terminological changes

Analysis (2/2)

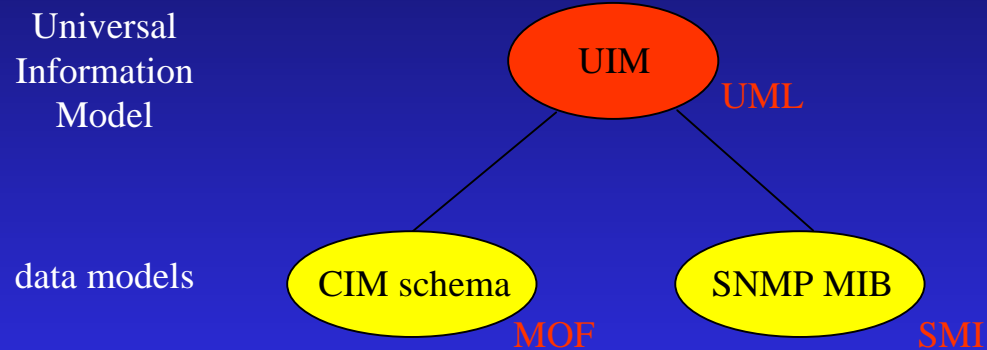
- With one-tier info. models, we try to do too many things at a time, and require too many skills from the same people:
 - ◆ Split between conceptual and implementation models
- Software quality is best assured by attracting the best people to fulfill each task throughout the software development process:
 - ◆ Attract the best technology experts and the best info. modelers in standards bodies

Two-Tier Models



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The Big Picture



One UIM per Technology (1/2)

- UIM = object-oriented abstract model
- Independent of management architecture:
 - ◆ indep. of data repository
 - ◆ indep. of communication protocol
 - ◆ communication and information models are indep.
- Durable:
 - ◆ stable terminology
 - ◆ no need to retrain people

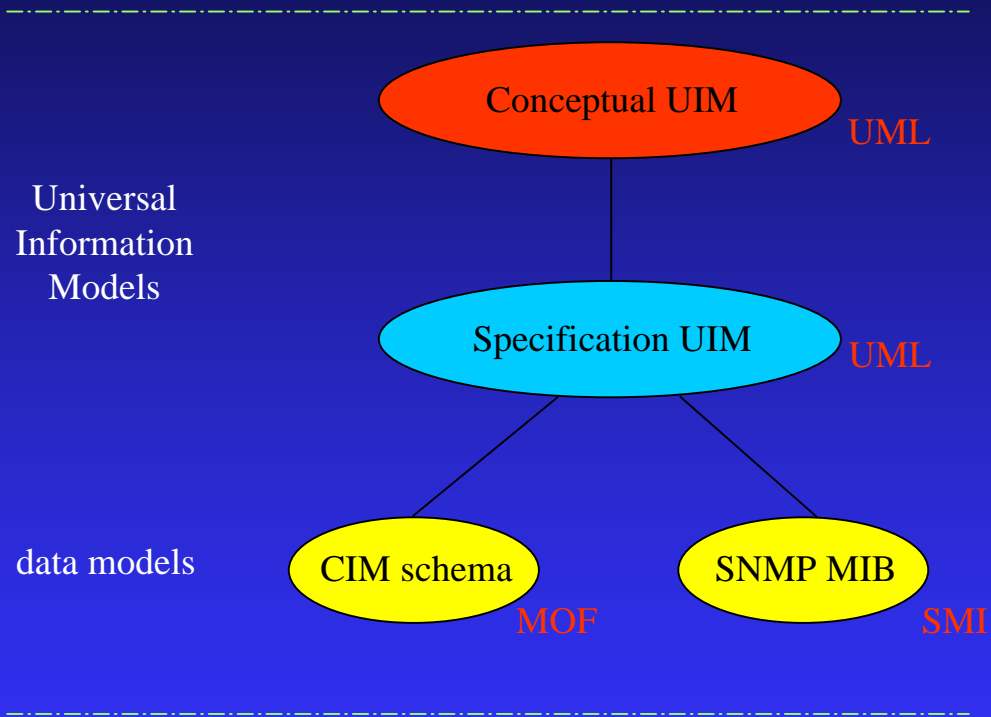
One UIM per Technology (2/2)

- Reusable:
 - ◆ shared by IETF, DMTF, etc.
- Expressed in UML + whitepapers
- Goal: convey the big picture to humans, not machines or compilers. Ignore details.
- Uses OMG's UML metamodel
- Devised by joint IETF/DMTF WGs:
 - ◆ researchers, independent consultants, end users
 - ◆ best technology experts, best mgmt. info. modelers

Multiple Data Models per Technology

- Several data models derived from a single UIM:
 - ◆ SNMP MIB
 - ◆ CIM schema
 - ◆ LDAP directory schema
 - ◆ etc.
- Not necessarily object oriented
- Language for devising data model: not prescribed
- Devised by separate WGs:
 - ◆ mainly vendors developing mgmt. applications

More than Two Tiers



Conclusion



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Summary

- We described several problems pertaining to mgmt. info. modeling in the IP world
- We proposed to alleviate them by using two-tier models
- We advocated the cooperation between standards bodies:
 - ◆ share conceptual models
- We recommended multi-specialization:
 - ◆ *UIMs*: designers and technology experts
 - ◆ *data models*: specialists of SMI, MOF, etc.

Future Work

- Define conceptual UIMs:
 - ◆ Joint work under way at AT&T and Cisco
 - ◆ Reverse-engineer SNMP MIBs
 - ◆ Reverse-engineer CIM schemas
- Several data models are derived from a single UIM. Does it facilitate the translation between these data models?
- Do UIMs require an equiv. to the DMTF's Core Model?